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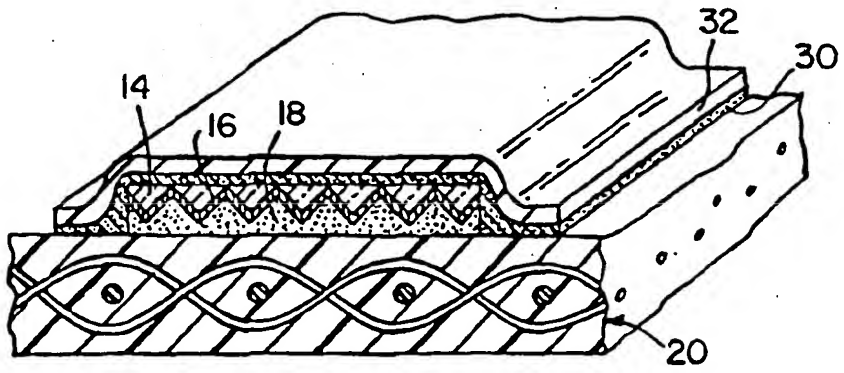
(54) Title: RETROREFLECTIVE STRUCTURE




(57) Abstract

A retroreflective structure is described in which an array of free-standing retroreflective prisms is formed on a suitable substrate for application of the structure to pre-existing structure formed of compatible fabrics, such as tarpaulins.

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# RETROREFLECTIVE STRUCTURE

## Background of the Invention

Retroreflective materials are commonly employed for safety and decorative purposes. One type of retroreflective material is formed of molded members having very small prisms or cube corner formations. (See, for example, U.S. Patent 3,810,804.)

It is often desirable to apply these materials to pre-existing structures; in which case, the retroreflective material may not be compatible with the material of the pre-existing structure or the method of application may be destructive of the retroreflective properties.

A need exists, therefore, for a retroreflective system and process in which the retroreflective material may be fabricated to facilitate permanent transfer to existing structures of different material without damaging the retroreflective material.

## Summary of the Invention

A method and apparatus for forming retroreflective material on a substrate is described in which a release coating is formed on a base material and an array of solid light transparent prisms are formed on the coating by casting the prism array in a plastic oligomer which is adhered to the coating.

The prisms are then made reflective by forming a metal layer on the prisms. An adhesive is then applied to the reflective metal layer. A substrate is then applied to the adhesive and the base material is removed at the release coating, leaving an exposed array of free-standing

prisms, i.e., prisms with a reflective metal backing affixed to the substrate.

The substrate is preferably formed of the same material as the structure upon which the retroreflective material is to be secured or is compatible with such structure. For example, the substrate may comprise a sheet of synthetic resin, such as polyvinylchloride (PVC), polyamide, polypropylene, polycarbonate, or fabrics such as polyester, nylon, or the like, coated with a suitable resin.

Preferably, the substrate with the exposed prism layer may then be covered with a transparent protective layer on the exposed side and the substrate may then be bonded by various well-known techniques to a pre-existing structure of the same or similar material as the substrate.

Brief Description of the Drawings

Figures 1A-1F are process flow schematic cross-sectional views showing the main steps in the fabrication of the retroreflective material of the invention on a substrate.

Figure 2 is a schematic cross-section showing further modification to the Figs. 1a-1f embodiment.

Figure 3 is a schematic perspective showing a tape formed in accordance with the invention.

Figure 4 is a section showing an alternate tape embodiment of the invention.

Figure 5 is a detailed sectional view showing the prism orientation.

Detailed Description of the Invention

The invention will now be described in detail in connection with the drawings. Referring to Figs. 1a-1f, a preferred embodiment will be described in which the substrate comprises tarpaulin material. This is a particularly appropriate example, since a need exists for a simple and inexpensive method of attaching retroreflective material to truck tarpaulins for safety reasons.

As shown in Figure 1A, the starting structure consists of base sheet 10 of material, such as a polyester sheet with an acrylic print treatment on one side (sold by DuPont under the name J Film). A release coating 12 formed of a polyester solvent borne tie cast is applied to the treated side of a 1-4 mils thick sheet 10.

Next, as shown in Figure 1B, an array of mircoprisms 14, about 2.8 mils high, are formed on the release coating by casting the present array onto an epoxy or urethane oligomer and adhering it to the coating.

Preferably, the prisms are of the type formed of cube corners in which the 3 faces intersect at 90° angles and in which the optical and prism axis are coincident, although non-perfect cube corner prisms to achieve special optical effects are within the contemplation of this invention.

The prisms 14 are made reflective by coating the exposed prisms surface with a metal layer 16, such as aluminum, gold or silver of about 500-800 Å (Figure 1C).

The structure of Figure 1C is inverted and an adhesive, such as a one component moisture curing reactive poly-urethane adhesive 18 (sold by MACE Corp.) is applied to the metallized prism side in a continuous stripe format of about 50 mm stripe length (Figure 1D).

The substrate 20, shown here as a tarpaulin material formed of a polyester cloth 22 encapsulated by a plastic material 24, is then laminated to the adhesive 18 (Figure 1E) and the base sheet 10 is stripped away (Figure 1D). This leaves stripes of an array of exposed (free) retroreflective prisms 14 adhered to the substrate 20 by adhesive 18 (Figure 1F). Light rays R incident upon the face of the prism 14 are retroreflected back by surface 16.

The resultant structure shown in Figure 1F may be further processed, as shown in Figure 2, by coating the free prism side with an adhesive 30 and laminating a clear protective sheet 32 of material, such as polyvinyl, to the structure. The structure shown in Figure 2 may then be slit into strips to form tapes, as shown in Figure 3.

Alternately, as shown in Figure 4, the free prism side shown in Figure 1F may be coated with a material 36 adapted to form a good bond with both the substrate 20 and the free prisms 14.

For example, if the substrate is formed of tarpaulin with an acrylic lacquer coating, then an elastomeric urethane coating would be a good choice for material 36.

Other substrate materials may comprise fabric reinforced and embossed vinyl, coated vinyl, urethanes, polypropylenes and the like.

As shown in Figure 5, an important feature of the present invention is that the prisms 14, because they are relatively free to move, become somewhat oriented by the shape of the substrate material 20, which improves the retroreflected light distribution.

CLAIMS

The invention claimed is:

1. A method for forming a retroreflective structure, comprising the steps of:
   a) temporarily affixing an array of transparent prisms to a sheet of base material;
   b) forming a reflective layer on the prisms;
   c) affixing a substrate to the reflective layer side of the prisms; and
   d) removing the sheet of base material leaving an exposed array of retroreflective prisms formed on the substrate.

2. The method of Claim 1 wherein the transparent prisms are cube-corner prisms.

3. The method of Claim 1 wherein the substrate is a tarpaulin.

4. The method of Claim 1 wherein the substrate is a fabric reinforced by plastic.

5. The method of Claim 1 wherein a light transparent adhesive is applied to the array and a light transparent protective layer is adhered to the array by the adhesive.

6. A method for forming a retroreflective structure, comprising the steps of:
   a) affixing an array of transparent retroreflective elements to a sheet of base material;

b) forming a reflective layer on the retroreflective elements;

c) affixing a substrate to the reflective layer of the retroreflective elements;

d) removing the sheet of base material, whereby said retroreflective elements are exposed; and

e) applying a protective sheet to the exposed retroreflective elements, thereby forming the retroreflective structure.

7. The method of Claim 6 wherein the transparent retroreflective elements are cube-corner prisms.

8. The method of Claim 6 wherein the protective sheet is a thermoplastic.

9. The method of Claim 8 wherein the thermoplastic is a polyvinyl chloride.

10. The method of Claim 6 wherein the substrate is a tarpaulin.

11. The method of Claim 6 wherein the protective sheet is an elastomeric.

12. A method for forming a retroreflective structure, comprising the steps of:

a) forming an array of cube-corner prisms on a sheet of base material;

b) forming a metalized layer on the cube-corner prisms;

c) applying a flexible substrate to the metalized layer;

d) removing the sheet of base material, whereby said cube-corner prisms are exposed; and

e) applying a protective sheet to the cube-corner prisms, thereby forming the retroreflective structure.

13. The method of Claim 12 wherein the formed retroreflective structure is formed into a tape.

14. A retroreflective structure comprising:

a) a substrate;

b) a layer of free-standing transparent prisms formed on said substrate; and

c) a reflective layer formed on the prisms.

15. The structure of Claim 14 wherein the substrate is formed of a fabric reinforced with plastic.

16. The structure of Claim 14 wherein the substrate is formed of a tarpaulin.

17. The structure of Claim 14 wherein the structure is formed into a tape.

18. The structure of Claim 14 wherein the prisms are cast in a transparent plastic material.

19. The structure of Claim 14 wherein the prisms are bonded to the substrate with an adhesive.

20. The structure of Claim 14 wherein the reflective layer is a metal layer.

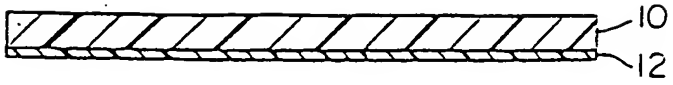


FIG. 1A

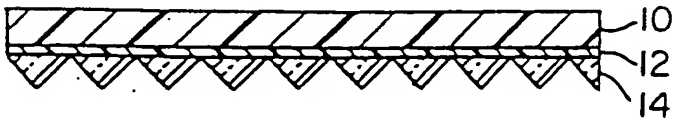


FIG. 1B

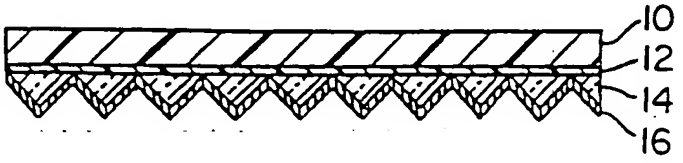


FIG. 1C

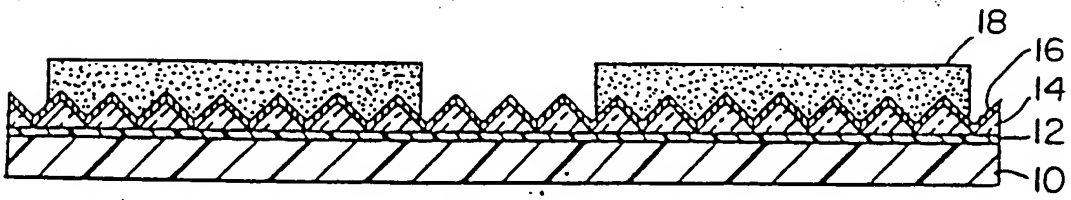


FIG. 1D

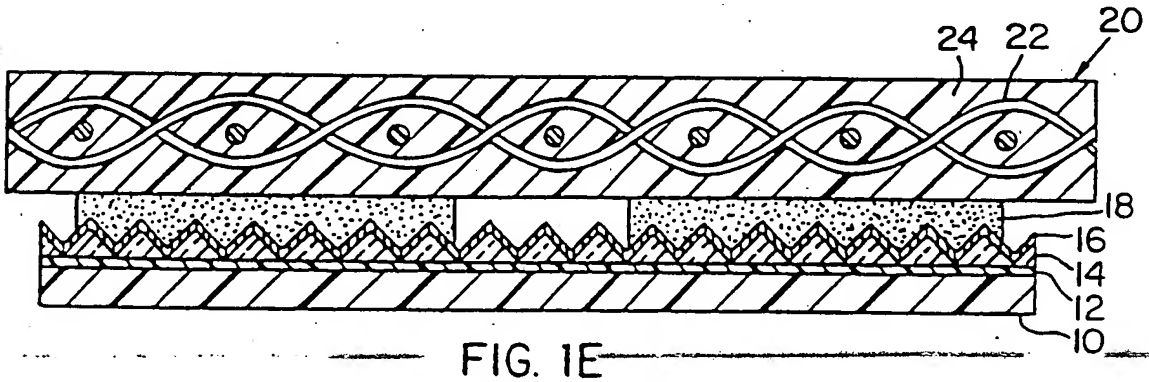


FIG. 1E

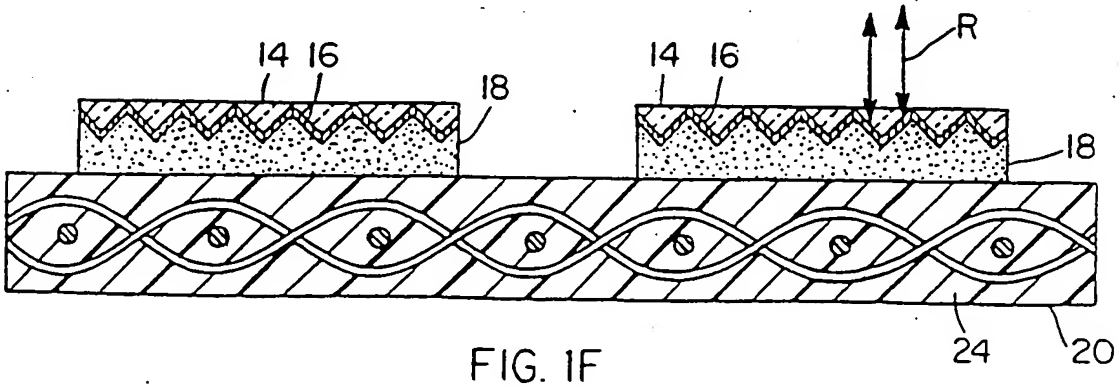


FIG. 1F

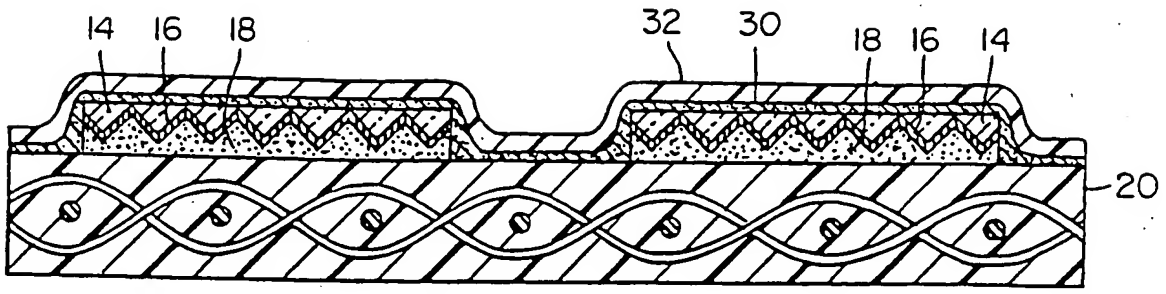


FIG. 2

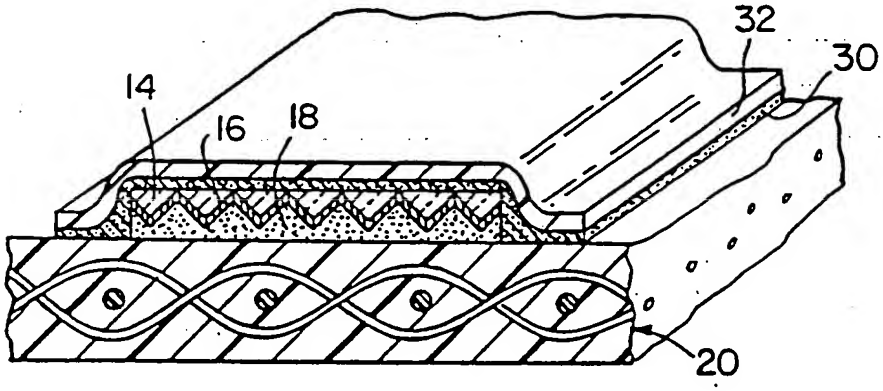


FIG. 3

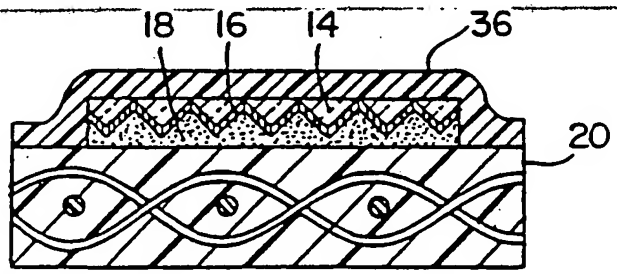


FIG. 4

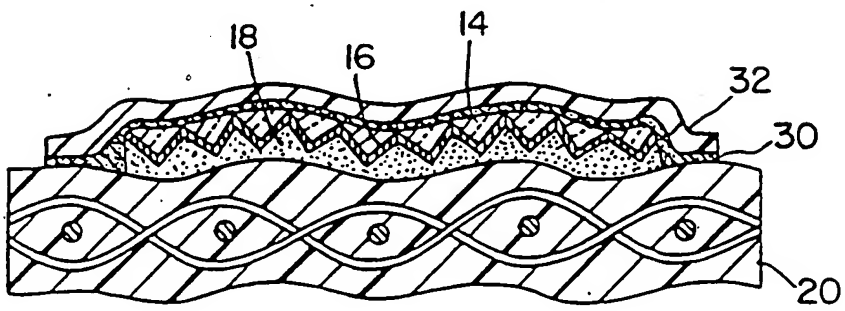


FIG. 5

# INTERNATIONAL SEARCH REPORT

Intern al Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 G02B5/124 G02B5/136

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
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